

Data Report and Summary Analyses of Limited-Entry Trawl Permits

West Coast Groundfish Observer Program

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Photo: NOAA Fisheries

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INTRODUCTION

Overview

This report summarizes discarded catch data collected by the West Coast Groundfish Observer Program (WCGOP) from the limited-entry (LE) trawl fleet from January 1, 2005 through April 30, 2006. The WCGOP collects at-sea data from LE trawl and fixed gear fisheries as well as from open access near-shore, prawn/shrimp, California halibut, and deep water fisheries. The WCGOP's goal is to improve total catch estimates by collecting information on the discarded catch (fish returned overboard at-sea) of west coast groundfish species. The data is used in assessing and managing a variety of groundfish species.

West Coast Limited-Entry Groundfish Trawl Fishery

The LE groundfish trawl fishery off the west coast of the United States operates from the Canadian border to Morro Bay, California. In 2005, there were 178 LE trawl permits of which 169 were active in the bottom trawl fishery. Active is defined for these purposes as the permit being identified to a vessel. Eleven of the 178 permits are associated with factory processors who fish only for Pacific hake and are observed by the At-Sea Hake Observer Program (ASHOP).

Groundfish bottom trawl vessels range in size from 35 to 95 feet and average 65 feet. Vessels fish throughout the year in both nearshore (0 – 50 fathoms) and offshore waters (> 50 fathoms) and deliver catch to shoreside processors. Bottom trawlers often target species assemblages, which can result in very diverse catch, especially when compared to single species trawl fisheries, such as Pacific hake. A single groundfish bottom trawl tow often includes fifteen to twenty species. Fish size and weight of the total catch also vary widely. Groundfish trawl vessels retain the portion of their catch that is marketable and permitted to be landed. The portion of the catch which is not marketable or for which regulations prohibit landing is discarded at-sea.

Active management of the fishery began in the early 1980's with the establishment of Optimum Yields (OY) for several managed species and trip limits for widow rockfish, the *Sebastes* complex, and sablefish. The objective of trip limits has been to slow the pace of landings to maintain year-round fishing, processing, and marketing opportunities. Since the 1980's, regulations have evolved to further separate individual groundfish species for management purposes and led to the current use of cumulative two-month landing limits for most species.

Fisheries managers and enforcement officers use state-issued sales receipts, referred to as fish tickets, and vessel logbooks to monitor fishery landings. Fish ticket and vessel logbook data are transferred to the Pacific Coast Fisheries Information Network (PacFIN) regional database system by state fishery

agencies in Washington, Oregon, and California. Fish tickets are useful for monitoring the fishery throughout the year. Trip limit amounts may be changed through in-season management based on the fish ticket data. However, fish tickets only provide information on the amount of fish landed. In order to ensure that total catch does not exceed annual OY, managers also need discard information for each managed species. One of the best means of acquiring accurate data needed to estimate the amount of discarded catch is through an at-sea observer program.

West Coast Groundfish Observer Program

On May 24, 2001, NOAA Fisheries (National Marine Fisheries Service, NMFS) established the WCGOP in accordance with the Pacific Coast Groundfish Fishery Management Plan (50 CFR Part 660) (66 FR 20609). This regulation requires all vessels that catch groundfish in the United States Exclusive Economic Zone (EEZ) from 3-200 miles offshore to carry an observer when notified to do so by NMFS or its designated agent. Subsequent state rule-making has extended NMFS's ability to require that California and Oregon vessels which only fish in the 0-3 mile state territorial zone to also carry observers. Observers are stationed along the US west coast from Bellingham, Washington to San Diego, California.

Program Goals

The WCGOP's goal is to improve estimates of total catch and discard by observing groundfish fisheries along the US west coast. Originally, the WCGOP focused observer effort in the LE trawl and fixed-gear fisheries. In 2002, the WCGOP began deploying observers in open access fisheries while increasing its coverage of the LE trawl fishery. In 2005, the WCGOP increased its coverage of the LE fixed-gear fishery and in 2006, the WCGOP improved coverage of the open access nearshore fishery. Currently, the WCGOP coverage goal is to maintain, at a minimum, 20% coverage of the LE trawl and fixed-gear fisheries while continuing to improve coverage in the open access fisheries. The observer coverage plan is available at: <http://www.nwfsc.noaa.gov/research/divisions/fram/observer/observersamplingplan.pdf>.

METHODS

Permit Selection Process for Limited-Entry Trawl

Limited-entry trawl permits are selected for observation using stratified random sampling. First, the WCGOP determines the amount of time (based on available resources) it will take to observe the entire fleet; this is termed the selection cycle. The selection cycle varies due to changing priorities and observer resources. Because of the data and timeline requirements for fisheries management and historical observer program vessel coverage, the selection cycles do not coincide with the date range of the observer data analyzed in this report. The data in this report were collected during two selection cycles. The date range for the two selection cycles were January 1, 2005 to August 31, 2005 (selection cycle 5)

and September 1, 2005 to June 30, 2006 (selection cycle 6). It should be noted that selection cycle 6 was two months longer than selection cycle 5. The length of the selection cycle was increased in order to allocate more resources to the open access nearshore fisheries.

	2005												2006					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Selection Cycles	Selection Cycle 5												Selection Cycle 6					
Report Data	Date Range of Report Data																	

In selection cycle 5, 169 LE trawl permits were selected for observer coverage and in selection cycle 6 there were 132 permits selected for observer coverage. To avoid selecting vessels that have not been participating in the LE bottom trawl fishery, prior to selection cycle 6, the WCGOP classified permits meeting the following criteria as inactive:

- Permits that did not land any groundfish using trawl gear between January 1, 2005 and December 31, 2005.
- All permits associated with catcher-processors or motherships that only participate in the offshore component of the Pacific hake fishery.
- Permits that were associated with recently sunk vessels or that are owned by deceased or terminally ill persons.
- Permits associated with “unidentified” vessels.

The inactive permits were then removed from the selection list for cycle 6.

The WCGOP aggregates locations along the US west coast into port groups, which are considered strata. Vessels with LE trawl permits are assigned to a port group based upon the location of the previous year’s landings. Within each port group, the vessels are randomly selected for coverage for a two-month period, which coincides with the two-month cumulative trip limit periods. After the entire fleet has been selected, a new selection cycle begins. This selection process is designed to produce a logistically feasible sampling plan with a distribution of observations throughout the entire geographic range of the fishery and throughout the two-month periods. Based on this design and the current level of WCGOP funding, the program is currently cycling through the LE trawl fleet every eight to ten months.

For more information on the rational behind vessel selection, see the observer coverage plan at: <http://www.nwfsc.noaa.gov/research/divisions/fram/observer/observersamplingplan.pdf>

Vessel Coverage

The LE trawl fleet is one of WCGOP’s highest priorities for observer coverage. Nearly all trips taken within the two-month period by a vessel whose permit has been selected are covered by an observer. However, sometimes vessels whose permits are selected for a specific two-month period may not be covered by an observer during that period or may not be covered on all trips during that period. Single

trips may be waived from observer coverage due to observer availability or a safety issue that can be fixed in a relatively short period of time. A few LE trawl vessels are given selection cycle waivers. A selection cycle waiver allows the vessel to fish without an observer during all trips taken during the entire selection cycle. Selection cycle waivers are given when a vessel has a serious safety concern that cannot be easily remedied.

Some vessels may receive a coverage period waiver. Coverage period waivers allow a vessel to fish all trips during a two-month period without an observer. Coverage period waivers are given for a variety of reasons including participation in a different fishery (i.e. crab, shrimp), observer availability, and vessel safety. Vessels are given a coverage period waiver for a specified two-month time period and are added to the selection list for the next two-month period. For instance, if a vessel is given a coverage period waiver for January 1 through February 28, that vessel is automatically selected for observer coverage for the period March 1 through April 30. Vessels continue to be added in the subsequent selection list until either an observer covers them or until the selection cycle ends, whichever comes first.

Trawl Data Collection

Fisheries observers are trained professionals who monitor and record catch data on commercial fishing vessels by following protocols in the WCGOP Manual (NMFS 2005a, current manual available at: <http://www.nwfsc.noaa.gov/research/divisions/fram/observer/observermanual/observermanual.cfm>).

Data collected by the observers on a trip basis include:

- Start time, end time, depth, and the start and end location of tows
- Gear type and fishing strategy
- Fish ticket identification numbers

Data collected by the observers on a tow basis include:

- Estimated total catch weight (including tows for which there is 100% discard)
- Weight of discard by catch category
- Reason for discard by catch category or species
- Species composition of discard by catch category
- Weight of fish retained by catch category
- Species composition of fish retained by catch category
- Catch of prohibited species and incidental take of protected species
- Size composition, tags, and viability assessments for Pacific halibut
- Size composition of discarded fish
- Basic taxonomic composition of non-fish bycatch
- Biological collections (otoliths, maturity, food habits, genetic samples, etc.)

For more information regarding observer sampling on trawlers, refer to the WCGOP Observer Training Manual, Chapter 4 – Trawl Sampling at: <http://www.nwfsc.noaa.gov/research/divisions/fram/observer/observermanual/observermanual.cfm>.

Data Quality Control and Management

The WCGOP uses the following procedure to ensure that the quality of the data collected is maintained:

- Data are collected at-sea by the observer following protocols in the WCGOP Manual (NMFS 2005a).

- Data are entered into the database system. The data are entered into a centralized Oracle database located at the Northwest Fisheries Science Center (NWFSC). Data within the Oracle database are accessible via a web-based GUI or by direct SQL queries to the database. A list of data tables is located in Appendix A.

- Observers are debriefed by WCGOP staff after every two-month cumulative trip limit period. The debriefing includes:

 - Calculation, Data Form, and Sampling Methodology Checks – Observers send data to a debriefer on a monthly basis. The debriefer checks all calculations for accuracy, reviews data forms for completeness, and ensures appropriate sampling methodologies were employed.

 - Observer Logbook Review - Observers keep logbooks detailing the events of each trip, basic deck schematics, sampling methods used, communication logs, and confirmation of a current safety decal. Any tows during which sampling problems occurred are documented in the logbook and reviewed during debriefing.

 - Interview – The observer is interviewed by the debriefer. During the interview, sampling methodologies employed on all trips are discussed and data errors are updated.

 - Evaluation - Observers are evaluated on their performance based upon WCGOP generated criteria.

 - Data Entry Check - Electronic data are compared to the raw data for keypunch errors. Also, all corrections discovered during debriefing are updated in the database program.

- Database Quality Control Queries - Quality control queries are run to detect data that fall outside specified ranges and identify other inconsistencies between data elements. These database quality control queries are run every six months to a year on all data collected during a specified time period.

- Database Update - The raw data from all entries that are highlighted by the QC queries are reviewed and the electronic data are updated.

Finally, data are then considered complete and are released to the analyst.

Data Processing

After quality control, WCGOP data are processed and merged with fish ticket data to provide more accurate estimates of bycatch. First, the subsamples of catch categories are expanded to the entire catch category at the tow level. Second, the WCGOP data are then matched to fish tickets and the observer estimates of total weight of the retained catch categories are adjusted to match the fish tickets weight. Fish tickets are completed by processors and include the actual weight and composition of fish landed. Finally, the catch categories found only on the fish tickets (but not in observer data) are distributed across the tows by multiplying the weight in the catch category by the percent weight of the observed catch in each tow.

A tow-level expansion is needed to estimate the total retained and discarded weight for each species because of the sampling procedure that derives the species composition. If the species composition of a catch category is mixed, an observer may take a subsample from the catch category. The following equation is used to calculate the weight of the subsample by summing across the observed weights of the individual species

$$w_j = \sum_i x_{ij}$$

where

x_{ij} = observed weight of the species i in catch category j in the subsample,
 w_j = weight of the subsample from catch category j .

The sampling ratio (R_j) used to scale the subsample weights to the amount in the catch category is calculated by dividing the weight of the subsample by the total weight of the catch category using the equation:

$$R_j = w_j / y_j$$

where

y_j = the total weight of catch category j .

The tow-level expanded weight of species i in category j is calculated by dividing the species weight in the subsample by the sampling ratio in the following equation:

$$X_{ij} = x_{ij} / R_j$$

where

X_{ij} = the weight of species i in catch category j .

Tallying the weight (X_{ij}) of the species (i) across all categories (j) within a tow provides the total weight of the species retained or discarded.

Fish tickets are trip-aggregated sales receipts for marketable species/categories. Fish ticket information is uploaded from state databases into the regional PacFIN database on a monthly basis and is subject to update frequently thereafter. The WCGOP data are linked to fish tickets by direct fish ticket number(s) obtained by the observer and/or by comparing the return date recorded by the observer with the dates of fish tickets from the vessel. For trips with multiple fish tickets, the fish ticket data are combined for analysis purposes. For trips with missing fish tickets, the WCGOP data are not adjusted.

The WCGOP data are adjusted so that the total trip pounds of retained fish in a catch category (as recorded by the observer) matches the total trip pounds on the fish ticket, because the fish ticket weight is often more accurate. To match the total trip pounds, the weights within each observer retained catch category are scaled up or down by the ratio of fish ticket and observer trip weights for that category, using the following equation to calculate the adjustment factor:

$$A_{jkm} = x_{jkm} / \sum_k x_{jkm}$$

where

x_{ikm} = lbs in catch category j in tow k in trip m

A_{jkm} = adjustment factor used for catch category j in tow k in trip m .

The equation used to adjust the WCGOP data is:

$$x'_{jkm} = A_{jkm} \cdot C_{jm}$$

where

C_{jm} = lbs in catch category j for trip m recorded on the fish ticket.

When a catch category in the WCGOP data cannot be matched to a fish ticket species category, the WCGOP data are not adjusted.

Catch categories found only on the fish tickets were distributed across the tows using the proportion of the observed catch per tow divided by the total observed catch per trip using the following equation:

$$B_{km} = \text{Total weight per tow} / \text{Total weight per trip} = \sum_j \sum_i x_{ijk} / \sum_k \sum_j \sum_i x_{ijk}$$

$$C_{jkm} = B_{mk} \cdot C_{jm}$$

where

B_{km} = the proportion of observed catch in tow k in trip m

C_{jkm} = lbs in catch category j for tow k in trip m recorded on the fish ticket.

Analysis

The dataset analyzed includes bottom trawl tows made using both large and small footrope gear configurations. Trawlers using gear other than bottom trawl gear (Danish/Scottish seine, of which there is only one vessel) were excluded from this analysis because results from this report are used solely to manage the bottom trawl groundfish fishery. In previous years, trawlers fishing under exempted fishing permits (EFP) had been excluded from the analysis because they fished under different regulations, but for the data time frame of this report, none of the trawl vessels were fishing an EFP. Trips from LE trawl vessels targeting California halibut were also excluded from the analysis. The exception is in Table 1, which includes those trips targeting California halibut because determining target strategy from the fish ticket data alone is not trivial. For information related to LE trawl vessels targeting California halibut, refer to the 2005 summary report online at: http://www.nwfsc.noaa.gov/research/divisions/fram/observer/datareport/docs/summary_observed_groundfish_bycatch_groundfish_limited_entry_vessels_targeting_california_halibut.pdf (NMFS 2005b).

Rates were calculated for a particular species as pounds discarded per hour of towing, pounds discarded per one-hundred pounds of groundfish retained, and pounds caught (retained plus discarded) per one-hundred pounds of groundfish retained. The ratio estimator technique (Cochran 1977) was used to estimate bycatch and discard rates for 35 selected species or species groups. The fish species selected for estimation were all of the overfished groundfish stocks, prohibited species (salmon, Pacific halibut), and other assessed stocks. The ratio estimates (R_{ijk}) were calculated by area (i), depth range (j), and period (k):

$$R_{ijk} = \sum_t y_{ijkt} / \sum_t x_{ijkt}$$

where y_{ijkt} is the discarded or retained pounds of a species in the tow t .

Three denominators (x_{ijkt}) are presented here: duration in hours of the sampled tow t , total catch in pounds of the target species, and total catch of all groundfish in the tow t . The first denominator is an un-standardized catch-per-unit-effort for the area-depth-period stratum. The second and third denominators are used to provide different perspectives for these preliminary analyses. The variance of R_{ijk} is approximated by using the following equation (Cochran 1977):

$$Var(R_{ijk}) = \frac{1}{n} \left(\frac{\bar{y}_{ijk}}{\bar{x}_{ijk}} \right)^2 \left[\frac{s^2(y_{ijkt})}{\bar{y}_{ijk}^2} + \frac{s^2(x_{ijkt})}{\bar{x}_{ijk}^2} - 2 \left(\frac{\sum_t (y_{ijkt} - \bar{y}_{ijk})(x_{ijkt} - \bar{x}_{ijk})}{\bar{y}_{ijk} \bar{x}_{ijk}} \right) \right]$$

where

\bar{x}_{ijk} , and \bar{y}_{ijk} are the means of x_{ijkt} and y_{ijkt} over the tows and $s(x_{ijkt})$ and $s(y_{ijkt})$ are the standard errors of x_{ijkt} and y_{ijkt} .

Note that $\text{Var}(R_{ijk})$ cannot be calculated when $y_{ijkt} = 0$ or $x_{ijkt} = 0$ for all tows and should be used with extreme caution when R_{ijk} is equal to one. This variance estimator was chosen in place of the previously used estimator from Pikitch et al. (1998) because the estimator from Cochran (1977) does not assume independence of the numerator and denominator.

RESULTS AND DISCUSSION

Overall Coverage Levels

In 2005, LE bottom trawl trips observed by the WCGOP accounted for 24% of coast-wide landings from all bottom trawl trips (Table 1). Coverage slightly decreased from the previous period coverage level of 27% in 2004 (NMFS 2005c, Table 1). During January thru April 2006, landings from the observed LE bottom trawl trips was 25% of the total tonnage for all LE trawl trips. The early 2006 coverage level indicates that the coverage rate is relatively constant.

Spatial Distribution of Observations

In 2005, the LE trawl fleet in Astoria, Newport, Coos Bay, and Crescent City had similar coverage levels (Table 1) relative to 2004, and the landings from these port groups constituted 59% of the overall landings by weight of the LE trawl fleet (NMFS 2005c, Table 1). Coverage of the LE fleet in the port groups of Bellingham, Neah Bay, Eureka, Fort Bragg, San Francisco, and Monterey Bay decreased and landings from these port groups constituted 39% of the overall LE trawl landings. Only Morro Bay had an increase in trawl coverage from 18% in 2004 to 31% in 2005. In 2005, Bellingham, Fort Bragg, and San Francisco had coverage of less than 20% and landings from these ports were 23% of overall LE trawl landings by weight. Coverage levels are subject to variation for several reasons. The WCGOP can control the number of boats observed, but not the amount of fish landed by these boats or the location of fishing effort. Coverage levels will fluctuate as a function of the amount of fish landed in a fishery and the amount of fish landed on the vessels observed, but these fluctuations are to be expected. In 2006, coverage levels vary along the coast (Table 1), which is not unusual given the small number of trips covered in several of the port groups (Table 2) and that coverage estimates only encompass four months as opposed to an entire year. It should also be noted that the level of fishing effort was lower in early 2006 (4,378 mt landed) than in early 2005 (7,246 mt landed). The small number of trips makes the metric tons observed sensitive to the fishing effort and success of the individual fishing vessels.

The numbers of trips observed within each port group during each two-month period are reported in Table 2. At this level of detail, the highly variable nature of observer coverage is revealed. Not only does the number of observed trips vary dramatically throughout the year within a port group, but so does that group's portion of the total observed trips. Several factors contribute to this variability, including weather-related impacts on fishing activity, the regional importance of other seasonal fisheries, such as shrimp and crab, regional differences in trip limits, and differences in the number and characteristics of vessels between port groups.

Plots summarizing the distribution of all LE bottom tows recorded in state logbooks and tows observed are presented for three sections of the west coast in Figures 1a-c. In these figures, trawl tows were assigned to 10 km by 10 km grid blocks based on the starting locations of the tows. The shading of each block reflects the number of logbook tows, with darker shading indicating more tows. The circles overlaid on each block reflect the number of observed tows, with larger circles indicating more tows. Blocks with the darkest shading and the smallest circles indicate fishing locations that received less observer coverage relative to fishing effort.

The spatial distribution of the LE trawl fleet and those tows observed by the WCGOP can be reviewed for general spatial sampling coverage in 2005. Figure 1a depicts the portion of the coast north of Coos Bay, Oregon. Figure 1b shows the area south of Coos Bay, Oregon to just north of San Francisco, California. Figure 1c portrays the California coast, as far south as Morro Bay. Within each of these areas, and for the coast as a whole, the spatial distribution of LE trawl tows appears to have been generally well sampled by observers during 2005.

The 2005 distribution of LE trawl fishing effort and observed tows can also be examined in terms of latitude and depth as depicted in Figure 2. The vertical lines at 100 fm and 150 fm provide reference points for understanding effects of the trawl Rockfish Conservation Area (RCA) on fishing location. In 2005, the trawl RCA eastern boundaries ranged from 75 to 100 fathoms and all waters shoreward of the western boundary (north of 36°) were closed from October to the end of December. The trawl RCA western boundaries ranged from 150 to 200 fathoms and shifted to 250 fm (north of 38°) in October for the remainder of the year. These spatial closures incorporated depths from 100 to 150 fathoms coast-wide for the entire year and a distinct lack of tows in this depth range is evident in Figure 2. LE trawl tows within these closed depths may be a result of the data representing the average depth of a tow and the fact that RCA boundaries approximate depth contours. Therefore, tows with an average depth reported between 100 and 150 fathoms may occur outside of the RCA boundaries.

Table 3 summarizes the depth distribution of observed tows by area and two-month period. Area strata are defined as north of 40° 10' N. latitude and south of 40° 10' N. latitude. Only a small amount of observed fishing effort in the south occurred in depths less than 150 fathoms. Coast-wide, the majority of observed trawl fishing effort in depths less than 150 fathoms occurs during the spring and summer

months from May through August.

Discard Estimates

All fish tickets were matched to the 495 observed trips in 2005 and only one fish ticket could not be found and matched to the 121 observed trips in 2006. In 2005, 10 trips had tows where species data was insufficient because of sampling difficulties, such as rough weather or observer illness and the retained catch could not be adjusted to match fish ticket data.

Additionally, a number of groundfish species assessed in 2005 had little to no observed discard in groundfish trawl tows. Therefore, these species were not incorporated into the tables. Kelp greenling was observed in 13 tows for a total of 63 lbs from 10 tows in the north and 3 lbs from 3 tows in the south at less than 75 fathoms. Cabezon was observed in 3 tows with 18 lbs of fish in the north and 2 lbs of fish in the south. Vermillion rockfish were observed in one tow with a total of 3 lbs in the south. Gopher rockfish and California scorpionfish were not observed in groundfish trawl tows.

Amounts of discarded and retained catch for 26 species or species groups of groundfish are provided in Table 4. The data are categorized by area and depth zone. This table also summarizes the distribution of observed discarded and retained fish by depth and the disposition of each species within a depth zone. Table 5 provides comparable information for California halibut, Pacific halibut, and chinook and coho salmon species. No sockeye, chum, or pink salmon were observed in any of the groundfish trawl tows.

Three different ratio estimators for discard of 35 groundfish and non-groundfish species or species groups are presented in Table 6. The three estimators are (1) discard per hour towed, (2) discard per one-hundred pounds of retained groundfish, and (3) discard of each species/group per pound of its own catch. Standard errors are also reported for each of the ratios. Results are summarized by area, depth zone, and two-month period. Periods with insufficient data for estimation were pooled. In 2006, data were insufficient to estimate ratios for tows between 75 and 150 fm in the north and in less than 150 fm in the south.

In many area-depth-period strata, the number of observed tows was very small (Table 3). In Tables 6 and 7, the following area-depth-period combinations had a small number of observed tows and were pooled: all periods at depths less than 150 fm in 2005 in the south, periods one and two at depths less than 150 fm in the north in both years, and periods five and six between 75 and 150 fm during 2005 in the north. In 2006, there were insufficient tows at depths less than 150 fm in the south and at depths between 75 and 150 fm in the north. In 2005, no tows were observed in period six at depths less than 75 fm. As a rule, rates of discard calculated relative to hours towed and retained groundfish exhibit the same direction of change across strata, however the magnitudes of change are not proportional. There is no consistent relationship between the percentage of a species that is discarded and the other two meas-

ures of discard in Table 6.

The vast majority of tows had no discard of the following overfished species: bocaccio rockfish, canary rockfish, cowcod rockfish, darkblotched rockfish, Pacific ocean perch, widow rockfish, and yelloweye rockfish (Figure 3). Sixty-five percent of the tows had no discard of lingcod, which was classified as rebuilt in 2006 (70 FR 75115). If discard occurred, most tows discarded less than 30 pounds of canary rockfish, darkblotched rockfish, and Pacific ocean perch. Eighteen percent of tows discarded more than 30 pounds of lingcod. The percentage of tows with canary rockfish discard increased slightly from 6% in 2004 to 8% in 2005. Also, the percentage of tows with lingcod discard increased from 28% in 2004 to 39% in 2005. The majority of bocaccio catch and discard occurred south of 40° 10' N. latitude (Table 4). Canary rockfish was primarily caught north of 40° 10' N. latitude and in depths of less than 150 fathoms. The majority of lingcod and widow rockfish were caught north of 40° 10' N. latitude. Pacific ocean perch were only caught north of 40° 10' N. latitude, primarily in depths greater than 75 fathoms. Yelloweye rockfish were also only caught north of 40° 10' N. latitude.

Skewed distribution of observations, exhibited by the extreme values of a few observations, can result in large standard errors for the ratio estimators relative to the ratios themselves. For each of the seven overfished species and lingcod, Table 7 presents the ratio estimate and standard error for total bycatch (discarded plus retained pounds) per one-hundred pounds of groundfish landed by area, depth zone, and two-month period. If area-depth-period strata had insufficient numbers of tows, the two-month periods were pooled. In some instances, an area was pooled across periods but the sample size was large enough for coastwide estimates by period. The method of calculating these bycatch ratios is very similar to that employed in developing parameters for the trawl bycatch model used by the Pacific Fishery Management Council for management of the LE trawl fishery. The denominator used to calculate rates in the bycatch model equals the sum of landed flatfish, thornyheads, sablefish, other roundfish, and rockfish. The bycatch rates presented here are calculated using total retained groundfish as the denominator.

In Table 8, the bycatch rates for each species from Table 7 are presented along with bycatch rates from previous WCGOP reports. In the north, RCA full year closures existed in 2003 from 100 to 200 fm, in 2004 from 75 to 150 fm, and in 2005 from 100 to 200 fm. Therefore, bycatch rates in the 75 to 150 depth strata are influenced by the lack of tows in portions of this stratum due to the closures.

In 2005 relative to 2004, bycatch rates of bocaccio rockfish, canary rockfish, and lingcod decreased south of 40°10' N. latitude in depths less than 75 fm, returning to levels similar to before 2004. For both canary and yelloweye rockfish, the highest bycatch rates occurred in the north between 75-150 fm. However, the bycatch rate for yelloweye rockfish in the north at less than 75 fm was similar to that in the 75 to 150 fm depth strata. The bycatch rates for bocaccio and cowcod in the south are greatest between 75 to 150 fm. Bycatch rates for widow rockfish in the south have remained at low levels. Darkblotched rockfish and Pacific ocean perch bycatch rates were greatest in the north at depths greater than

150 fm.

Continuing Unresolved Data Issues

Accurate calculation of bycatch rates requires linking observer discard estimates to the PacFIN database that includes official weights for species measured at the time of landing. The two principal sources of landings data are fish tickets and logbooks that have been adjusted using fish tickets. Matching WCGOP data with fish ticket and logbook data remains challenging due to the difference in data protocols among the states of Washington, Oregon, and California, and between the state agencies and the WCGOP.

Because catch categories recorded on fish tickets are recorded only at the trip level, distributing landed weight across individual tows is inevitably imprecise when tow specific WCGOP data is unavailable. This is particularly true when a trip consisted of tows in several different depth zones. The current approach is to distribute landings in proportion to each tow's percentage of the trip's total retained groundfish weight. Future work will evaluate the incorporation of additional information that may improve these assignments. For catch categories that exist in both fish ticket and observer records, the uncertainty in assigning weight differences between observed trip retained weights and the corresponding fish tickets is reduced, although not eliminated, by knowledge of the pattern of hauled catch throughout the trip.

Each of the west coast state agencies employs different procedures for adjusting fish ticket landings and logbook retained catch (Sampson and Crone 1997, Pearson and Erwin 1997, Clark 1986a, 1986b, 1988a, 1988b). Linking WCGOP records with corresponding logbook tow data is often difficult and time-consuming, due to the inconsistent adjustment protocols and other factors such as 1) incomplete logbook submission, 2) a significant number of logbook trips where tows are not recorded in chronological order, 3) the absence of some tows in logbooks, especially when no groundfish are retained, and 4) inaccurate recording of tow date, location, and depth. If these issues were resolved, the analysis of WCGOP data could be more comprehensive and timely.

It is expected that results from the 2005 WCGOP coverage presented in this report will be used in the fishery management process. When combined with additional sources of fishery information, these results can improve total catch estimates for west coast groundfish fisheries.

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APPENDIX A. Oracle Database

Database Table Hierarchy

TRIPS

- ▶ FISHING_ACTIVITIES
 - ▶ FISHING_LOCATIONS
 - ▶ CATCHES
 - ▶ SPECIES COMPOSITION
 - ▶ SPECIES_COMPOSITION_ITEMS
 - ▶ BIO_SPECIMENS
 - ▶ BIO_SPECIMEN_ITEMS
 - ▶ DISSECTIONS

Database Table Descriptions

The database tables listed in the table below are a subset of the total tables contained in the Oracle database. They represent the tables that are actually used to contain the WCGOP data collected by the WCGOP.

BIO_SPECIMENS	Sets of species physical measurements resulting from sampling catches occurring in a tow or set
BIO_SPECIMEN_ITEMS	Physical measurements collected for an individual fish, mammal or bird occurring in a biological sample
CATCHES	PacFIN catch category based on estimates of fish caught during a tow or set
CATCH_CATEGORIES	PacFIN catch categories
DISSECTIONS	Physical specimens collected for an individual fish, mammal or bird
FISHING_ACTIVITIES	Fishing tows or sets occurring during a trip
FISHING_LOCATIONS	Locations of tows or sets
PORTS	Coastal cities where fishing activity is based out of
SPECIES	Fish, mammal, and bird species that might be encountered during fishing
SPECIES_COMPOSITIONS	Sets of species weights and counts resulting from sampling catches occurring in a tow or set
SPECIES_COMPOSITIONS_ITEMS	Weights and counts for individual species occurring in a species composition sample
TRIPS	Sets of fishing activities that occur between the time a vessel leaves port and when it returns
VESSELS	Trawl, longline, pot, or other fishing vessels